VIA ELECTRONIC MAIL,
AND U.S. MAIL

June 6, 2007 SR-6J

Mr. Jerry C. Winslow
Principal Environmental Engineer
Xcel Energy
414 Nicollet Mall (Ren. Sq. 8)
Minneapolis, Minnesota 55401

RE: Final Remedial Action Objectives Technical Memorandum
Ashland/NSP Lakefront Superfund Site

Dear Mr. Winslow:

In accordance with the Administrative Order on Consent (AOC), CERCLA Docket No. V-W-04-C-764, Section X, Subparagraph 21(c), the United States Environmental Protection Agency (EPA) hereby modifies the Remedial Investigation Report (RI), Appendix A, Remedial Action Objectives Technical Memorandum (RAO) submitted by Northern State Power Company (NSPW) (d/b/a Xcel Energy, a subsidiary of Xcel Energy, Inc.) on May 16, 2007. By letter dated December 22, 2006, EPA provided NSPW a notice of deficiency regarding the RI including the RAO. EPA provided a second notice of deficiency on April 25, 2007, giving NSPW 21 days to cure the deficiency by incorporating EPA's modifications. EPA's modifications were not incorporated into the revised document; therefore, EPA invokes its right to modify a submission pursuant to Subparagraph 21(c). The attached document will be considered the approved final Remedial Action Objectives Technical Memorandum.

If you have any questions or would like to discuss things further, please contact me at (312) 886-1999.

Sincerely,

Scott K. Hansen
Remedial Project Manager

cc: Dave Trainor, Newfields
Jamie Dunn, WDNR
Omprakash Patel, Weston
Henry Nehls-Lowe, DHFS
Ervin Soulier, Bad River Band of the Lake Superior Chippewa
Melonee Montano, Red Cliff Band of the Lake Superior Chippewa

bcc: File, SR-6J
Craig Melodia, C-14J

APPENDIX A
REMEDIAL ACTION OBJECTIVES TECHNICAL MEMORANDUM

In accordance with the AOC, this Remedial Action Objectives Technical Memorandum was prepared to document objectives based upon human health and ecological risk assessment results. This document primarily focuses on the chemicals of potential concern (COPCs) for each media, potential exposure pathways and receptors, and acceptable contaminant levels, or range of levels (protectiveness), at particular locations for each exposure route. A brief summary of the Ashland Lakefront Site is provided along with an outline of the remedial alternatives process

A.1. INTRODUCTION

The Site contains property owned by NSPW, a portion of Kreher Park, the former Wastewater Treatment Plant (WWTP), and a portion of the Chequamegon Bay inlet area adjacent to Kreher Park. The primary contaminant source is the former manufactured gas plant which previously occupied the NSPW property. In addition, other possible industrial operations might have contributed to the contaminant source at Kreher Park.

Site characterization began in 1989 when apparent contamination was discovered at Kreher Park. The primary contaminants at the Site are derived from tar compounds, including volatile organic compounds (VOCs) and polycyclic aromatic hydrocarbons (PAHs). Soils, groundwater, and offshore sediments have been impacted. Additionally, free-product derived from the tars is present as a non-aqueous phase liquid (NAPL) in the upper reaches of a filled ravine on the NSPW property, at Kreher Park including the former "seep" area, in the off-shore sediments, and in the upper elevations of the deep Copper Falls aquifer. The free-product in the deep aquifer is surrounded by a dissolved phase contaminant plume that extends north from the area of the free-product in the direction of groundwater flow. Although contaminants have migrated down gradient in the underlying Copper Falls aquifer, both the vertical and lateral extent of contamination is limited by strong upward gradients that create artesian conditions at the Lakefront.

NSPW implemented interim removal actions in 2000 to mitigate exposure risks to contaminants and to recover free-product from the deep aquifer. A low-flow pumping system currently extracts free-product from the deep aquifer, treating the entrained groundwater before discharging it to the City of Ashland's sanitary sewer. Additionally, NSPW installed an extraction well at the base of the filled ravine that was the source of the seep discharge at Kreher Park. This extraction well was part of a larger interim action that included excavation of contaminated materials at the former seep area and placement of a low-permeability cap to eliminate the intermittent seep discharge and mitigate environmental exposure of the associated contaminants.

This Remedial Action Objectives Technical Memorandum is the first of three submittals to identify the need for corrective action, and, develop and screen remedial options in accordance with the November 2003 AOC. Subsequent documents will screen appropriate technologies. Treatability studies may also be conducted. A Detailed Analysis of Alternatives (Feasibility Study) will be prepared as the final submittal of these documents.

A.2 CHEMICALS OF POTENTIAL CONCERN

The primary contaminants at the NSPW Site consist of VOCs and semi-volatile organic compounds (SVOCs). Benzene is the most commonly occurring VOC. SVOCs consist predominantly of a group of PAH compounds. The most commonly occurring PAH at the Site is naphthalene. Some metals (lead, thallium and arsenic) and inorganic compounds (cyanides) have also been found, but these are sporadic are not considered significant COPCs.

The baseline revised Human Health Risk Assessment (HHRA) (URS, 2007) used a tiered, risk-based approach to evaluate COPCs for the various exposure scenarios. The results of the HHRA evaluation found the following COPCs for the Site.

List of COPCs Identified by the HHRA

Surface Water	Groundwater	Sediment	Soil	Fish	Indoor Air
Benzo(a)anthracene	1-Methylnaphthalene	Antimony	1-Methylnaphthalene	1-Methylnaphthalene	1,2,4-Trimethylbenzene
Benzo(a)pyrene	2-Methylnaphthalene	Iron	2-Methylnaphthalene		1,4-Dichlorobenzene
Benzo(b)fluoranthene	Acenaphthene	Manganese	Acenaphthene	Benzo(a)anthracene	Benzene
Benzo(k)fluoranthene	Benzo(a)anthracene	Vanadium	Benzo(a)anthracene		Carbon tetrachloride
Chrysene	Benzo(a)pyrene	1-Methylnaphthalene	Benzo(a)pyrene	Benzo(e)pyrene	Trichloroethylene
Dibenzo(a,h)anthracene	Benzo(b)fluoranthene	2-Methylnaphthalene	Benzo(b)fluoranthene	Benzo(b)fluoranthene	
Indeno(1,2,3-cd)pyrene	Benzo(k)fluoranthene	Benzo(a)anthracene	Benzo(k)fluoranthene	Dibenzo(a,h)anthracene	
	Chrysene	Benzo(a)pyrene	Chrysene	Dibenzofuran	
	Dibenzo(a,h)anthracene	Benzo(b)fluoranthene	Dibenzo(a,h)anthracene		
	Dibenzofuran	Benzo(k)fluoranthene	Dibenzofuran		
	Fluoranthene	Indeno(1,2,3-cd)pyrene	Fluoranthene		
	Fluorene	Naphthalene	Fluorene		
	Indeno(1,2,3-cd)pyrene		Indeno(1,2,3-cd)pyrene		
	Naphthalene		Naphthalene		
	Phenanthrene		Phenanthrene		
	Pyrene		Pyrene		
	1,2,4-Trichlorobenzene		1,2,4-Trichlorobenzene		
	1,2,4-Trimethylbenzene		1,2,4-Trimethylbenzene		
	1,3,5-Trimethylbenzene		1,3,5-Trimethylbenzene		
	Benzene		Benzene		
	Ethylbenzene		Ethylbenzene		
	Toluene		Toluene		
	Total Xylenes		n-Butylbenzene		
			Sec_Butylbenzene		
			Total Xylenes		
			Arsenic		
			Lead		
			Thallium		

In the HHRA, the toxicity assessment provides a framework for characterizing the relationship between the magnitude of exposure to a chemical and the nature and likelihood of adverse health effects that may result from such exposure. Chemical toxicity is typically divided into two categories: carcinogenic and noncarcinogenic. Potential health effects are evaluated separately for these two categories, because their toxicity criteria are based on different mechanistic assumptions and associated risks are expressed in different units. Thus, the COPC list was refined using toxicology, pathways, and exposure during the HHRA for the Site. No COPCs were identified in the HHRA for groundwater because groundwater is not used as a potable water supply, though construction worker exposure to groundwater is possible. At the former Waste Water Treatment Plant (WWTP), trespassers who enter the buildings can potentially inhale vapors and have direct dermal contact with contaminated groundwater and NAPLs that have infiltrated the flooded lower level of the facility. The COPCs identified for surface water include PAHs. The COPCs identified for sediment include metals and PAHs. PAHs were found to be COPCs in fish. Several volatile compounds were identified COPCs in indoor air.

The Baseline Ecological Risk Assessment (BERA) (URS, 2006) evaluated data for all media, including all historical data, to screen and select COPCs from an ecological perspective. Screening was conducted for the various media using appropriate benchmarks. The results of the BERA evaluation found the following constituents of concern for the Site.

List of COPCs Identified by the BERA

Surface Water	Sediment	Soil
None	Total PAHs	Total PAHs
	Dibenzofuran	Benzene
	m-Cresol	Antimony
	o-Cresol	Barium
	p-Cresol	Cadmium
	1,2,4-Trimethylbenzene	Chromium
	1,3,5-Trimethylbenzene	Copper
	Benzene	Lead
	Ethylbenzene	Manganese
	Toluene	Mercury
	Total Xylenes	Selenium
	Antimony	Silver
	Arsenic	Thallium
	Barium	Zinc
	Cadmium	Cyanide
	Copper	
	Iron	
	Lead	
	Manganese	
	Mercury	

Surface Water	Sediment	Soil
	Nickel	
	Selenium	
	Silver	
	Thallium	
	Vanadium	
	Zinc	
	Cyanide	

In the BERA, the COPCs were evaluated based on concentrations, pathways, receptors, and likely effects. PAHs were the primary COPC addressed in the BERA.

A.3 POTENTIAL EXPOSURE PATHWAYS AND RECEPTORS

The exposure pathway links the sources, types of environmental releases, and environmental fate with receptor locations and activity patterns. Generally, an exposure pathway is considered complete if it consists of the following four elements:

- A source and mechanism of release;
- A transport medium;
- An exposure point (i.e., point of potential contact with an impacted medium); and
- An exposure route (e.g., ingestion) at the exposure point.

Release mechanisms and transport pathways were evaluated for the Site. Listed below are potential cross-media transfer mechanisms of chemicals:

- Chemicals in subsurface soil may enter groundwater through infiltration/percolation;
- Chemicals in surface soil may be transported to surface water and sediments through surface runoff and backfilling;
- Chemicals in groundwater may be transported to surface water and sediments through groundwater discharge;
- Chemicals in groundwater may be infiltrating the lower level of the former WWTP located in Kreher Park;
- Chemicals in surface soil may be transported to the atmosphere via volatilization or fugitive dust emission;
- Chemicals in soil or groundwater may be transported to the atmosphere or indoor air through volatilization;
- Chemicals in surface water and sediments may be transported to the tissues of aquatic organisms or higher trophic levels through bioaccumulation; and
- Chemicals in sediments may be released to surface water when sediments are disturbed.

A.3.1 Human Health Receptors and Exposure Scenario

Presented below is an overview of exposure pathways of potential concern selected for further evaluation in the HHRA. Potential receptors are discussed based on medium of interest (i.e., soil, groundwater, sediment, surface water, biota, and air). Updates to the receptor populations identified in the Final Work Plan (URS, 2005) are discussed as necessary.

A.3.1.1 Exposure to COPCs in Soil

Residential Land Use Scenario: Child and Adult Residents

Upper Bluff - There is a residential area located upgradient from the Kreher Park area of the Site at the upper bluff area northeast of the former ravine. Described below were three exposure scenarios assumed in the HHRA for the residential receptors:

Exposure to surface (0-1 ft) and subsurface soil (1-10 feet bgs).
This assumption was made because new construction would involve excavation of soil for the construction of footings or basements. Therefore, subsurface soil would be brought to the surface resulting in a potential exposure pathway for residential receptors. This scenario represents the worst case for residential receptors, but is not likely to be the actual scenario associated with the Site.

Exposure to surface soil.
The residential neighborhoods adjacent to the Site are established neighborhoods and are expected to remain so in the future. According to the Ashland Wisconsin Waterfront Development Plan, the future use of the Kreher Park portion of the Site does not include a residential scenario. In an established residential setting and without intrusive activities, receptors would most likely be exposed to surface soil.

Exposure to soil in 0-3 ft bgs.
For informational purposes, COPCs in soil between 0 and 3 ft bgs were also considered for residential receptors based on the assumption that receptors could potentially be exposed to soil from 0-3 ft bgs when performing landscaping or gardening activities.

For the purpose of the HHRA, child and adult residents were assumed to be exposed to COPCs in soil via incidental ingestion, inhalation (of soil-borne vapor and particulates) and dermal contact pathways.

Recreational Use Scenario: Child, Adolescent and Adult Visitors

Kreher Park is now zoned as City parkland. Child, adolescent and adult visitors are assumed to be exposed to COPCs in surface soil via incidental ingestion, inhalation (of soil-borne vapor and particulates) and dermal contact pathways.

Industrial/Commercial Land Use Scenario: Maintenance Workers

Although the final Work Plan indicated maintenance workers currently access the Site, additional information collected during the RI indicates that City workers and utility maintenance personnel do not access the Site. However, the City may develop the existing marina and expand it into the affected area for recreational use. Therefore, a potential future maintenance worker was considered a receptor to surface soil at Kreher Park and the unpaved portions of the Upper Bluff area. It is conservatively assumed that maintenance workers may be exposed to COPCs in surface soil via incidental ingestion, inhalation (of soil-borne vapor and particulates) and dermal contact pathways.

Industrial/Commercial Land Use Scenario: General Industrial Workers

Except for the NSPW facility, no other industrial/commercial facilities exist within the Site. For this HHRA, general workers are defined as NSPW employees involved with non-intrusive, operational activities. Current and potential future general workers are not likely to be subject to significant exposure to environmental media in the normal course of their daily work. Although the potential for exposure to occur is expected to be low, general workers are assumed to be exposed to COPCs in surface soil via incidental ingestion, inhalation (of soil-borne vapor and particulates) and dermal contact pathways.

Industrial/Commercial Land Use Scenario: Construction Workers

Upper Bluff and Kreher Park - It is conservatively assumed that construction activities could take place at every area included in this evaluation and it is possible for construction workers to be exposed to COPCs in surface and subsurface soil via incidental ingestion, inhalation (of soil-borne vapor and particulates) and dermal contact pathways. For this HHRA subsurface soil is defined as a depth of 10 feet or less, which is a conservative estimate of the limit to which construction activities may occur based on the current and proposed future land use at the Site.

A.3.1.2 Exposure to COPCs in Indoor Air – Residents and Industrial Workers

Upper Bluff - The residential area located upgradient from Kreher Park at the upper bluff area northeast of the former ravine was evaluated. For the purpose of the HHRA, child and adult residents were assumed to be potentially exposed to COPCs volatilizing from soil and groundwater and entering the residences located near the ravine. In addition, potential exposures to COPCs in indoor air were also evaluated for industrial workers who may enter the NSPW service center/vehicle maintenance building periodically.

Kreher Park – trespassers who enter the former WWTP can potentially inhale vapors released to contaminated groundwater and NAPLs that have infiltrated the flooded lower level of the facility. The potential health risks associated with this exposure pathway was part of the RI/FS work plan (URS, 2005), but was not quantitatively evaluated by the HHRA and is a data gap. This exposure pathway was not quantitatively evaluated because access to the interior of the plant was restricted during the RI/FS study and no samples could be collected. Additionally, earlier indoor air analyses results collected by the City of Ashland (2002) were not available for review as part of the HHRA. Despite this shortcoming, direct contact exposures to NAPL or "free-product" in groundwater may pose an unacceptable health risk.

A.3.1.3 Exposure to COPCs in Groundwater: Trespassing Land Use Scenario

The final Work Plan indicated that groundwater in the seep area was a potential exposure point for trespassers. However, this exposure point was eliminated because the seep area was capped as part of the 2002 interim action response (URS, 2002). This exposure pathway is no longer complete and was not quantitatively evaluated in the HHRA.

Another potential point of exposure to groundwater is the former WWTP building where groundwater has infiltrated into the basement. The building is locked and the perimeter is fenced with warning signs posted. A quantitative evaluation for the potential trespasser exposures to the indoor air and water inside the former WWTP building was not performed due to the lack of data.

Industrial/Commercial Land Use Scenario: Construction Workers

Kreher Park - It is conservatively assumed that construction activities could take place at every area included in this evaluation and it is possible for construction workers to be exposed to COPCs in shallow groundwater at Kreher Park via incidental ingestion, inhalation of vapors, and dermal contact pathways. For this HHRA, shallow groundwater is defined as a depth of 10 feet or less, which is a conservative estimate of the limit to which construction activities may occur based on the current and proposed future land use at the Site.

Residential and Industrial/Commercial Land Use Scenarios

Groundwater is present in both the water table aquifer and a confined deep aquifer. Currently the shallow groundwater is not used as a potable water source. There are two artesian wells in the Site vicinity—one located near Prentice Avenue on the eastern boundary of the Site and the other located near the marina on the western boundary. Both wells draw water from the Copper Falls aquifer, the confined deep aquifer that is separated from the shallow groundwater by the

Miller Creek Formation (URS, 2005; ATSDR, 2003). The City of Ashland restricted public access to these wells for public use in August 2004. To date water from these wells have met all federal and state safe drinking water standards. Water from these artesian wells is considered safe to drink as Site-related chemicals have not been detected in these wells at levels of concern (ATSDR, 2003).

Except for the two artesian wells, the Copper Falls aquifer is not used for drinking water and is not considered a source of human exposure. Shallow groundwater at the Site is not a drinking water source for the City of Ashland. Drinking water at the Site is provided by the City of Ashland that draws its water from intakes in Lake Superior, located approximately one mile northeast of the Site outside the known extent of surface water contamination. Therefore, there are no known receptors to shallow groundwater beneath the Site.

A.3.1.4 Exposure to COPCs in Surface Water and Sediments

Recreational Use Scenario: Child, Adolescent and Adult Visitors to Kreher Park and Chequamegon Bay

The Site is surrounded by facilities that draw the public to the lakefront – a City marina, public swimming beach, a boat ramp and an RV park and campground. Child, adolescent and adult visitors are assumed to be exposed to COPCs in surface water and sediments via incidental ingestion, inhalation of vapors, and dermal contact pathways while swimming, wading, fishing, or boating. However, only risks associated with swimming and wading activities were quantified in the HHRA. This is because they represent activities that have the greatest contact with impacted media and are considered more conservative than exposures associated with fishing and boating.

A.3.1.5 Exposure to COPCs in Fish Tissue

Subsistence fishers were selected as the fishing receptors because there are two Chippewa Bands (the Bad River Band and the Red Cliff Band of Lake Superior Chippewa) who may use Chequamegon Bay as their source of fish. For the HHRA it was conservatively assumed that adult subsistence fishers may be exposed to COPCs via ingestion of locally-caught fish. Although this scenario was selected based on the presence of the two Chippewa Bands, this exposure scenario and the selected exposure parameters are applicable to any subsistence fisher ingesting fish from Chequamegon Bay.

A.3.2 Ecological Receptors and Exposure Scenario

In the BERA (URS, 2006), the potential risk to ecological receptors was evaluated for benthic macroinvertebrates, fish, birds, and mammals. The potential contact points for ecological receptors include surface water, surface soil and food/prey in terrestrial habitats; and, surface water, sediment and food/prey in aquatic and wetland habitats.

Each of these contact points and their respective exposure media were addressed in the BERA.

Routes of Entry

The potential routes of entry for ecological receptors are:

- Direct contact: dermal and/or gill absorption;
- Ingestion; and,
- Inhalation.

In the exposure analysis the relationship between receptors at the Site and potential stressors (chemical, biological, or physical entities that may result in adverse effects to one or more receptors or groups of receptors) were evaluated. Exposure point calculations (EPCs) used to estimate exposure were calculated as the 95% upper confidence limit of the mean (UCL_{95}) of the exposure medium. EPCs calculated for sediment, soil, or tissue residues were based directly upon the levels of contaminants in these media. There were no COPCs for surface water.

Exposure estimates for birds and mammals were calculated using food web models. Simplified food web models were developed to calculate average daily doses (ADDs) of COPCs that representative receptors experience through exposure to sediment, and surface soil at the Site. The ADD represents the dose of a chemical that a receptor may ingest if it foraged within designated exposure units. ADDs for wildlife receptors are calculated using (1) exposure-point concentrations for prey and media developed for each, (2) COPC-specific bioaccumulation factors or bioaccumulation models for dietary items, and (3) receptor-specific exposure parameters and food chain model assumptions, (e.g., diet composition, foraging area, amount of incidental soil or sediment ingested, etc.).

Risk Characterization

Risk Characterization was the final phase of the BERA. In Risk Characterization, the information from the effects and exposure analyses were used to determine a probability of adverse effects to receptors of concern and discuss the strengths, weaknesses, and assumptions in the BERA. Risk estimates (or Hazard Quotients) were developed for each assessment endpoint based upon comparison of site-specific media concentrations and/or estimated ingested contaminant dose estimates (the latter for wildlife) to effects levels (generic criteria, benchmarks and TRVs) for the various ROCs. Finally risk was characterized for each assessment endpoint by integrating the risk estimate with the results of other lines of evidence, if available.

The results of the risk characterization indicated that there are potentially unacceptable impacts to the benthic macroinvertebrate community in aquatic portions of the Site. Two lines of evidence, bulk sediment chemistry and sediment toxicity testing, indicated that the probability of impairment at the community level was likely. Effects observed from the URS field surveys of the existing benthic community indicated effects that were less dramatic than those demonstrated in the laboratory toxicity studies, but interpretation of the field survey data is made very difficult by a high degree of variability and lack of comparability between reference and site stations.

The BERA concluded that the potential for adverse effects to ecological receptors other than benthic macroinvertebrates was not sufficient to result in significant adverse alterations to populations and communities of these ecological receptors.

A.3.3 Remedial Action Objectives

The specific goals of the remedial actions are defined by acceptable contaminant levels, or a range of levels at each location for each exposure route. The acceptable contaminant level (or protectiveness) is determined based on the findings of the HHRA and the BERA. The general goal of these objectives is to protect human health and environmental receptors at risk due to constituents at the site. These objectives are subject to the criteria evaluated in the FS, and include:

- Eliminate or reduce potential risks to human health and to aquatic and terrestrial animals and to the environment from exposure to contaminants;
- Eliminate future migration of contaminants to receptors;
- Eliminate on-site migration of contaminants;
- Eliminate or reduce contaminant migration to Chequamegon Bay;
- Remove or reduce free-product (NAPL) present at the upper bluff (filled ravine/NSPW property and the Copper Falls Aquifer);
- Remove or reduce free product (NAPL) at Kreher Park;
- Remove or reduce free product (NAPL) from the sediments in Chequamegon Bay;
- Minimize short term risk to human health and to aquatic and terrestrial animals and to the environment: from exposure to contaminants during the implementation of the remedial action.

The HHRA was based upon the protection of human health. The BERA was based upon a risk management goal of maintenance (or provision) of soil, sediment, water quality, food source, and habitat conditions capable of supporting a "functioning ecosystem" for the ecological populations inhabiting or using the Site. The HHRA was used to develop RAOs for soil, and the BERA was used to development RAOs for surface water and sediment. Although HHRA results indicate that groundwater is not currently used as a potable water supply, construction workers may encounter groundwater in a trench. RAOs for dissolved phase and free-phase (tar) groundwater contamination were also developed for groundwater. The development of RAOs is described in the following sections. RAOs for site media are summarized below.

Remedial Action Objective Summary by Site Media

Environmental Media	Receptor	Preliminary Remedial Action Objectives
Groundwater	Human Health	Protect human health by eliminating exposure (direct contact, ingestion, inhalation) to groundwater with COPCs in excess of regulatory or risk-based standards; reduce contaminant levels in groundwater to meet MCLs and State of Wisconsin Drinking Water Standards
	Environment (Ecological Receptors)	Protect the environment by controlling the off-site migration of contaminants in groundwater to surrounding surface water bodies which would result in exceedance of ARARs for COPCs in surrounding surface waters.
		Conduct free product removal to halt or contain the discharge of a hazardous substance or to minimize the harmful effects of the discharge to the air, land or water.
Soil	Human Health	Protect human health by reducing or eliminating exposure (ingestion/direct contact/inhalation) to soil having COPCs representing an excess cancer risk greater than 10^{-6} as a point of departure (with cumulative excess cancer risks not exceeding 10^{-5}) and a hazard index (HI) greater than 1 for reasonably anticipated future land use scenarios.
		Ensure future beneficial commercial/industrial use of the site and recreational use of Kreher Park.
	Environment (Ecological Receptors)	Protect populations of ecological receptors or individuals of protected species by eliminating exposure (direct contact with or incidental ingestion of soils or prey) to soil with levels of COPCs that would pose an unacceptable risk.
		Conduct free product removal to halt or contain the discharge of a hazardous substance or to minimize the harmful effects of the discharge to the air, land or water.
		Protect the environment by minimizing/eliminating the migration of contaminants in the soil to groundwater or to surrounding surface water bodies.
Surface Water	Human Health	Protect human health by minimizing exposures (direct contact, ingestion, inhalation) to surface water that has been impacted by Site-related groundwater and sediment with concentrations of COPCs such that regulatory or risk-based surface water standards have been exceeded.
	Environment (Ecological Receptors)	Protect the environment by controlling the migration of contaminants in groundwater and in sediments to surface water which would result in exceedance of ARARs for COPCs in surface water.
		Reduce Site-related COPC levels in the surface water to meet State of Wisconsin Surface Water Quality Standards.

Environmental Media	Receptor	Preliminary Remedial Action Objectives
Sediments	Human Health	Protect human health by eliminating exposure (direct contact, ingestion, inhalation, fish ingestion) to sediment with COPCs in excess of regulatory or risk-based standards.
	Environment (Ecological Receptors)	Protect populations of ecological receptors or individuals of protected species by eliminating exposure (direct contact with incidental ingestion of sediments or of prey) to sediment with levels of COPCs that would pose an unacceptable risk.
		Conduct free product removal to halt or contain the discharge of a hazardous substance or to minimize the harmful effects of the discharge to the air, land or water.

The basis and rationale for soil remediation objectives is protection of reasonable future uses. This includes industrial, commercial and utility worker protection and protection of recreational users of Kreher Park. The basis and rationale for groundwater remediation objectives is based on anticipated commercial/industrial and recreational land use. These objectives were developed to eliminate exposure and protect against off-site migration of contaminants. The basis and rationale for surface water remedial objectives are to minimize the potential for contaminant exposure to surface water users and reduce migration of groundwater and sediment contaminants to surface water that could result in exceedance of surface water standards. The basis and rationale for sediment remedial objectives are to protect populations of aquatic organisms, including fish, and to protect against migration of contaminants from sediments to surface water.

A.3.3.1 HHRA Based Remedial Action Objectives for Soil, Surface Water and Groundwater

The results of the HHRA indicate that only residential exposure pathways (for soil depths between 0 to 3 feet or all soil depths to 10 feet bgs) and construction worker exposure pathways (for soil depths between 0 and 10 feet) are associated with unacceptable risks (Cancer Risk (CR) greater than 10^{-4} and Hazard Index (HI) greater than 1) based on exposures to soil in the filled ravine area for residential receptors and the Kreher Park area for construction worker receptors. However, residential receptors are not expected to be exposed to subsurface soil given the current and potential future land use of the Site. (Residential land use in Kreher Park is not anticipated, and residential land use in the upper bluff area is located outside the backfilled ravine where contamination has been identified.) For this Site, risks associated with exposures to surface soil are within acceptable risk ranges.

Although the results of the HHRA indicate risks for exposure to soils and the construction worker scenario exceed USEPA acceptable levels, the assumptions used to estimate risks to this receptor were conservative and considered the worst case. Given both the current and future land use of the Site, it is not likely that construction workers would be exposed to subsurface soil at depths beyond 4 feet bgs (a typical depth for the installation of underground utility corridors), as most activities associated with the implementation of the future land use would be associated with subsurface activities such as regrading, landscaping, and road or parking lot construction. The risk for exposure of construction workers to groundwater was based upon exposure to free product (NAPL), using data for NAPL from samples collected from the free product recovery system currently removing free product from the Copper Falls Aquifer. Although exposure of construction workers to free product with concentrations of chemicals similar to what is collected in recovery wells is highly unlikely and introduces substantial uncertainty into quantification of this exposure pathway, this analysis was conducted at EPA's request. The results of this analysis indicated a carcinogenic risk ranging between 3×10^{-5} and 7×10^{-3} and non-carcinogenic (hazard indices) risk of between 2×10^{-1} and 3×10^{3}. However, based on the above discussion, risks to this receptor population from soil and groundwater exposure are most likely overstated.

Risks to recreational users (surface soil), waders and swimmers (sediments), industrial workers (surface soil), and maintenance workers (surface soil) are all within USEPA's acceptable range of 10^{-4} to 10^{-6} (and do not exceed a cumulative risk of 10^{-5}) for CR and 1 for HI. Risks to subsistence fishers (finfish) was at 10^{-4} and risk to a wader contacting surface water ranged from 2×10^{-5} to 6×10^{-5}.

At EPA's request, an analysis of a swimmer or wader incidentally ingesting and dermally contacting oil material (sheens) in surface water was also conducted. Using the same data from the free-product recovery system as described for dermal exposure to construction workers, risks to swimmers and waders exposed to potential oil slicks in surface water were calculated. In the unlikely event a swimmer or wader contacted oily material (sheens) in surface water 12 days a year the CR would range from 4×10^{-3} to 5×10^{-2}. The non-cancer HI ranged from 4 to 7×10^{-2}. The CR to wader or swimmer for incidental ingestion of surface water ranged from 3×10^{-8} to 1×10^{-6}. The non-cancer HI ranged from 2×10^{-4} to 1×10^{-1}. All of these levels assume worst-case conditions and are associated with a high level of uncertainty.

Preliminary Remediation Goals for Soils and Surface Water

Based on the results of the Site-specific HHRA, preliminary remediation goals (PRG) were derived for the following exposure scenarios that exceeded a cumulative cancer risk of 10^{-5} or a cumulative noncancer risk of a hazard index (HI) of 1:

- Construction worker exposure to soil at Kreher Park;
- Residential exposure to soil at the Upper Bluff; and
- Recreational exposure to surface water.

PRGs were derived for chemicals identified as the primary risk drivers using exposure parameters that were used to develop the HHRA.[1] Presented below are chemical-specific

[1] PRGs were derived from the Region 9 Tables that can be found at http://www.epa.gov/region09/waste/sfund/prg/index.html

acceptable contaminant levels for these exposure scenarios based on target cancer risk goals of 10^{-4} to 10^{-6} and target noncancer risk goals of an HI of 0.1 and 1. PRGs are not developed for fish because remediation is not plausible for fish; rather, risks from consumption is controlled through consumption advisories, and fish contaminant levels will be reduced through sediment remediation. PRGs were not developed for the indoor air pathway; indoor air levels will be reduced through groundwater remediation.

Soil Preliminary Remediation Goals for Construction Workers (mg/kg)					
Chemical	Carcinogenic Effects			Noncarcinogenic Effects	
	CR = 10^{-6}	CR = 10^{-5}	CR = 10^{-4}	HI = 0.1	HI = 1.0
SVOCs					
2-Methylnaphthalene	NA	NA	NA	1.13E + 02	1.13E + 03
Benzo(a)anthrancene	2.01E + 00	2.01E + 01	2.01E + 02	1.06E + 04	1.06E + 05
Benzo(a)pyrene	2.01E - 01	2.01E + 00	2.01E + 01	NA	NA
Benzo(b)fluoranthene	2.01E + 00	2.01E + 01	2.01E + 02	NA	NA
Dibenzo(a,h)anthracene	2.01E - 01	2.01E + 00	2.01E + 01	NA	NA
Indeno(1,2,2-cd)pyrene	2.01E + 00	2.01E + 01	2.01E + 02	7.06E + 03	7.06E + 04
Naphthalene	NA	NA	NA	3.81E + 00	3.81E + 01
VOCs					
Benzene	1.4E + 00	1.4E + 01	1.4E + 02	4.11E + 00	4.11E + 01

Soil Preliminary Remediation Goals for Residents (mg/kg)				
Chemical	Carcinogenic Effects		Noncarcinogenic Effects	
	CR = 10^{-5}	CR = 10^{-4}	HI = 0.1	HI = 1.0
SVOCs				
Benzo(a)anthrancene	6.21E + 00	6.21E + 01	NA	NA
Benzo(a)pyrene	6.21E - 01	6.21E + 00	NA	NA
Benzo(b)fluoranthene	6.21E + 00	6.21E + 01	NA	NA
Dibenzo(a,h)anthracene	6.21E - 01	6.21E + 00	NA	NA
Naphthalene	NA	NA	1.70E + 00	1.70E + 01
VOCs				
Benzene	7.37E + 00	7.37E + 01	1.80E + 00	1.80E + 01

Surface Water Preliminary Remediation Goals for Swimmers (mg/L)					
Chemical	Carcinogenic Effects			Noncarcinogenic Effects	
	CR = 10^{-6}	CR = 10^{-5}	CR = 10^{-4}	HI = 0.1	HI = 1.0
SVOCs					
Benzo(a)anthrancene	2.04E - 04	2.04E - 03	2.04E - 02	NA	NA
Benzo(a)pyrene	1.17E - 05	1.17E -04	1.17E - 03	NA	NA
Benzo(b)fluoranthene	1.19E - 04	1.19E - 03	1.19E - 02	NA	NA
Dibenzo(a,h)anthracene	7.72E - 06	7.72E - 05	7.72E - 04	NA	NA
Indeno(1,2,2-cd)pyrene	1.17E - 04	1.17E - 03	1.17E - 02	NA	NA

Preliminary Remediation Goals for Groundwater

No COPCs were initially identified in the HHRA for groundwater because groundwater is not used as a potable water supply. However, exposure to contaminated groundwater and accompanying NAPLs can potentially occur via the following exposure scenarios:

- Construction worker exposure to shallow groundwater infiltrating trenches at Kreher Park; and
- Trespasser exposure to groundwater infiltrating the lower level of the former WWTP.

These pathways are further discussed and the PRGs for direct contact and inhalation of vapors from affected groundwater are presented under Section A.3.3.3 (Remedial Action Objectives for Media with No Exposure Pathways).

The COPCs in sediment included five PAHs, but the cumulative risks estimated for the recreational receptor exposures to sediments were below USEPA's target risk levels.

A.3.3.2 BERA Based Remedial Action Objectives for Sediment

The BERA effects analysis consisted of an evaluation of available toxicity or other effects information used to relate the exposure estimates to a level of adverse effects. Risk Characterization was the final phase of the BERA. The effects and exposure analyses were used to determine a probability of adverse effects to receptors. Risk estimates (or Hazard Quotients) were developed for each assessment endpoint based upon comparison of site-specific media concentrations and/or estimated ingested contaminant dose estimates to effects levels (generic criteria, benchmarks and toxicological reference values for the various receptors). Finally risk was characterized for each assessment endpoint by integrating the risk estimate with the results of other lines of evidence, if available.

Toxicity tests performed as part of the BERA indicated the potential for impairment to the benthic macroinvertebrate community in aquatic portions of the Site, as evidenced by pronounced toxicity in laboratory toxicity tests. Effects observed from field surveys of the existing benthic community indicated effects that were less dramatic than those demonstrated in the laboratory toxicity studies, but interpretation of the field survey data is made very difficult by a high degree of variability and lack of comparability between reference and site stations.

In addition, the sporadic release of free phase hydrocarbons from Site sediment during high energy meteorological events or when disturbed by other activities may result in episodic conditions that may limit the functionality of the aquatic community in the Site area. If normal lake front activities, i.e., wading, boating etc., were not presently prohibited, the disturbance of sediments and release of subsurface contaminants would increase. This potentially could lead to greater impacts than were measured during these RI/FS studies.

The BERA concluded that the potential for adverse effects to ecological receptors other than the benthic community was limited. Therefore the only PRG proposed is for the benthic community exposed to COPCs in sediment. Since PAHs are the most widespread COPCs at the Site and are the basis for most of the potential risk to ecological receptors these have been the focus of the BERA. A PRG focused on PAHs in sediment will address potential risk from other Site COPCs in sediment.

There were no COPCs in Site soil or surface water that contributed to unacceptable ecological risk.

Preliminary Remediation Goals

It was determined that levels of PAHs in sediments were the most significant contributor of potential risk to ecological receptors at the Site. Based upon the results of the BERA, exposure of ecological receptors to COPCs in groundwater and soils is not expected to result in unacceptable effects to populations of valued ecological receptors. There were only occasional low level detections of benzene, ethylbenzene, toluene and naphthalene in the filtered fraction of Site surface water and none of these detections exceeded screening criteria. No other COPCs were detected.

The overall goal for sediments at the Ashland site is protection of the survival, growth and reproduction of benthic invertebrate communities. The thresholds presented herein were derived from data collected through all iterations of sediment investigation at the site and is based on the best professional evaluation of sediment chemistry, bioassay and benthic community study data collected by SEH and NSPW as well as draws upon the considerable body of information on PAH toxicity to benthic organisms to supplement the Site data. Due to the uncertainty associated with the 2005 benthic community study statistical analysis (primarily associated with concerns about the reference locations), it was concluded that the analysis provided little value in supplementing the 1998 study and it did not lend value to the discussion of PRGs. The range of threshold values discussed below was found to be consistent with the distribution of site data and external chemical benchmarks.

Calculation of Thresholds for Benthic Species Tested for Ashland BERA

From the available data, it appears that of the three benthic species used in sediment toxicity tests, the midge *Chironomous dilutus* (formerly *tentans*) is the most sensitive. This is supported by both the comparative toxicity in sediment dilution series tested by SEH (2001) and by the literature data for water-only toxicity of fluoranthene reported by Schuler et al (2004; ES&T 38:6247). Therefore, if the goal is to derive an RAO that will protect these three species, then it is the toxicity threshold for midge that will set the threshold.

The first issue is to define what the threshold will be. Statistical significance is sometimes used to define toxicity thresholds, but this can be problematic because it is defined in large part by the concentrations tested and subtleties in data variability, neither of which is relevant to the expected biological effect of exposure. In recent years, greater emphasis has been placed on estimating specific levels of effect using various regression techniques. For this purpose, a 20 percent effect threshold (EC20) is often chosen. While it is difficult to establish whether this is a true "threshold" for adverse effect (i.e., all concentrations below this are "safe"), it becomes difficult to reliably estimate levels of effect lower than this. It also corresponds to a level of effect that is commonly found to be significant in toxicological testing. In selecting the EC20, it is recognized that this does not guarantee the absence of biological effect at this concentration; however, it will be presumed that levels of effect lower than this will be adequately addressed through natural attenuation of residual effects.

Within the toxicity tests conducted for the Ashland BERA, there is only one test that directly determines an EC20 for midge; that was the sandy sediment dilution test by SEH (2001). While this is in some ways the most direct method for estimating this value, this study has been criticized by NSPW because of anomalies in the analytical data that make the reported exposure concentrations somewhat uncertain. As a cross check on this value, one can use the larger body of available data to make estimates of the midge EC20 using responses in other tests and relationships among endpoints. The details of this analysis are described in detail in Attachment A, and are summarized in the table below. Estimates of the midge EC20 range from 1,340 to 3,930 μg PAH/g OC; converting to a dwt basis assuming a sediment OC of 0.415%, this corresponds to 5.57 to 16.3 μg PAH/g dwt. Because of the uncertainties involved, it may be most appropriate to think of the midge EC20 as a range rather than a single value.

Summary of Midge EC20 Estimates

Concentration (μg PAH/g OC)	μg PAH/g dwt @ 0.415% OC	Summary of Derivation
1,340	5.57	Treat SQT7 as *Hyallela* 28-d LC80; adjust from *Hyallela* 28-d LC80 to midge LC20 based on SEH (2001) dilution studies.
1,770	7.35	Treat SQT7 as *Hyallela* 28-d LC80; adjust from *Hyallela* 28-d LC50 based on URS (2006) and SEH (2001) dilution studies; adjust to midge LC50 based on Schuler (2004); adjust from midge LC50 to midge LC20 based on SEH (2001) dilution studies.
2,020	8.38	Midge LC50 predicted from Schuler (2004); adjustment from LC50 to LC20 based on SEH (2001) dilution study.
2,560	10.6	*Hyallela* 10-d LC50 from URS (2006) dilution study; adjust from *Hyallela* 10-d LC50 to midge LC50 based on Schuler (2004); adjust midge LC50 to midge LC20 based on SEH (2001) dilution studies.
3,930	16.3	Average of LC20 and EC20 from SEH (2001); test with dilutions of contaminated sandy sediment.

These values are still not as low as the calculated EPA ESB concentration of 557 µg PAH/g OC (2.31 µg PAH/g dwt at 0.415%). Among the reasons for this is that the EC20 midge is the lowest value among the three species, and would not necessarily protect even more sensitive species. Basing an RAO on the midge EC20 should be done in recognition that effects to highly sensitive organisms are possible, and may require additional attenuation of exposure over time to meet a more stringent definition of "threshold."

Based on the various data sources, the EC20 for midge is expected to lie within a range of 1,340 – 3,930 µg PAH/g OC. At an organic carbon (OC) of 0.415%, this corresponds to a range of 5.6 to 16.3 µg PAH/g dwt. The proposed PRG for sediment is 2,295 µg PAH/g OC (9.5 µg tPAH/g dwt at 0.415% OC), which is the geometric mean of the above range. For purposes of converting to a dry weight concentration so it can be applied equally throughout the Site, an organic carbon concentration of 0.415% was assumed for all Site sediment. Sampling by URS both on and off site clearly indicates OC contents well below 1% in sandy sediments. The mean of the OC measured in SQT1 and SQT7 is 0.415%. Whether this is the exact value that should be used warrants further evaluation; however, it is clear that a value lower than 1% is necessary to accurately reflect the toxicity of sandy site sediments.

This PRG does not include the added effects of UV and is based on a water depth of 6 feet or more. If the final depth of sediments will be less than 6 feet, the PRG for any active remedial intervention will be adjusted downward as based on UV extinction coefficients measured in Site waters. The adjusted PRGs (assuming no debris cover) are provided in the following table:

Water Depth	% of Surface Irradiance at Depth	24-h Average Irradiance (µgW/cm2)	PAH at LC20 (µg/g OC)	PAH at LC20 (µ/g dwt @ 0.415% OC)
5	88.1	860.6	143	0.59
10	81.8	799.5	154	0.64
25	65.6	640.9	192	0.8
50	45.4	443.4	277	1.15
100	21.7	212.2	579	2.4
150	10.4	101.6	1,210	5.02
200	4.98	48.6	2,530	10.5
232	3.11	30.3	4,050	16.8
250	2.38	23.3	5,280	21.9
300	1.14	11.1	11,000	45.8

This PRG would prevent direct contact with or ingestion of sediments or prey having levels of COPCs that would pose an unacceptable risk to populations of ecological receptors or individuals of protected species. The following factors support that conclusion:

1) This PRG meets the RAO because it protects populations of wildlife and fish.

a. The results of the BERA indicated that even under baseline conditions populations of wildlife, including waterfowl, would not be exposed to unacceptable risk of harm. Therefore, wildlife would be protected at a PRG of 2,295 μg PAH/g OC (9.5 μg tPAH/g dwt at 0.415% OC) since this is substantially less than the baseline conditions to which they are presently exposed.

b. The results of the BERA indicated that even under baseline conditions, adult fish were not directly exposed to sufficient levels of PAHs nor did they accumulate sufficient PAHs to pose a risk of harm. The sediment bioassay using the fathead minnow indicated the threshold for effects is greater than 60.8 μg PAH/g @1%OC and perhaps as high as 363.0 μg PAH/g @1%OC. The SEH dilution bioassay indicated an EC20 of around 94.0 μg PAH/g @1%OC (based upon USEPA's analysis). Based upon these two lines of evidence fish populations should not be exposed to risk or harm if a PRG of 2,295 μg PAH/g OC (9.5 μg tPAH/g dwt at 0.415% OC) were used since this is substantially less than the baseline conditions to which they are presently exposed.

2) This PRG protects benthos at the population and community level. USEPA has provided guidance that except for protection of the individuals of species of special concern, such as threatened and endangered species, protection of populations and communities of biota is the basis for a clean-up standard based upon risk to ecological receptors.[2]

a. Use of the EC20 is consistent with the data quality objective (DQO) for sediment bioassays which states "If control survival is equal to 80%, and the difference between Site survival or growth and reference station survival or growth is equal to 20% (statistically significant difference at $\alpha = 0.1$) it is indicative of unacceptable risks" (25 January 2005 BERA, Appendix G, Table 4, Data Quality Objectives for 28 day *Hyallela azteca* (Amphipod) with and without UV light and 20-day *Chironomous dilutus* (formerly *C. tentans*) *(Midge)* Sediment Bioassay).

b. The range of estimated midge EC20 values is consistent with the distribution of Site data and external chemical benchmarks. Figure 1 shows a summary of all available toxicity data for solid-phase toxicity testing of sandy sediments form the Ashland site (in the absence of UV light), combining data from SEH (1998), SEH (2001) and URS (2006). Also shown are WDNR TEC, MEC, and PEC effect endpoints, the EPA ESB value, and the range of midge EC20 estimates listed in

[2] USEPA Ecological Risk Assessment and Risk Management Principles for Superfund Sites (OSWER Directive 9285.7-28 P) indicates that, "Superfund remedial actions generally should not be designed to protect organisms on an individual basis (the exception being designated protected status resources, such as listed or candidate threatened and endangered species or treaty-protected species that could be exposed to site releases), but to protect local populations and communities of biota." (USEPA 1999).

the above Table. As can be seen, the midge EC20 range lies in an area that is consistent with the distribution of toxic and non-toxic samples, that is, most of the toxic samples lie to the right of this range, and most of the non-toxic samples lie to the left. Also obvious is the very limited amount of toxicological data in the critical range of PAH concentrations, primarily 600 to 6,000 µg/g organic carbon. Finally, the midge EC20 range is consistent with midrange of the WDNR guidance values.

Summary

A two-tiered sediment PRG is proposed to meet the RAOs in Table 1.

1) Sediments in greater than 6 feet of water having a concentration greater than 2,295 µg PAH/g OC (9.5 µg tPAH/g dwt at 0.415% OC) and sediments in 6 feet or less of water having a concentration greater than a UV-light adjusted PRG will be addressed with an active remedial intervention, i.e. by either removing or covering them to terminate any exposure pathways; and

2) Sediments in greater than 6 feet of water having a concentration equal to or less than 2,295 µg PAH/g OC (9.5 µg tPAH/g dwt at 0.415% OC) and sediments in 6 feet or less of water having a concentration greater than a UV-light adjusted PRG will be monitored to assure that there are no unacceptable impacts to the benthic community and that the levels of PAHs in surface sediments decrease over time to1,340 µg PAH/g OC (5.6 µg tPAH/g dwt at 0.415% OC) which is the lower of the range of midge EC20 values based on Site data.

In addition, although these conditions will likely address all sediments where there is free product (NAPL), the PRG is amended to explicitly provide for the removal of all sediments associated with NAPL even if they occur in areas where PAHs concentrations are lower than the proposed PRG of 2,295 µg PAH/g OC (9.5 µg tPAH/g dwt at 0.415% OC).

This proposed PRG is supported by and further defined by the following information:

- This two-tiered PRG will be applied to all sediments (both sediments that are primarily wood as well as those that are primarily sand).

- This PRG is based upon total PAHs as defined in the BERA. These are the sum of 24 PAHs used by NOAA in its Status and Trends program. Because effects levels for bioassays as well for the benthic community analysis were based upon the same 24 PAHs as were measured in the bulk sediment analysis, the 24 PAHs can represent all PAHs, measured and unmeasured. Only the assumption that the relative proportion of non-Status and Trends PAHs to all PAHs remains relative constant need be made. All nondetect PAHs will be included in the total calculation at one-half the detection limit, which is consistent with the approach used in the BERA.

- The proposed PRG will be applied to all sediments regardless of the sediment depth. Obviously this only makes a difference for removal alternatives.

- The sediment bioassays indicated that UV light caused increased toxicity to laboratory organisms. For sediments in depths of less than six feet, the PRG for any active remedial intervention will be adjusted downward as directed by USEPA based upon UV extinction coefficients measured in Site waters. Adjusted PRGs are shown above.

In summary, a two-tiered sediment cleanup level is recommended. A sediment cleanup level of 9.5 μg tPAH/g dwt at 0.415% OC will be used as the basis for implementing active remedial intervention. In addition sediments exceeding 5.6 μg tPAH/g dwt at 0.415% OC, which is lower of the range of midge EC20 values based on Site data, but less or equal to the cleanup level of 9.5 μg tPAH/g dwt will be monitored to assure that there are no unacceptable impacts to the benthic community and that the levels of PAHs in the surface sediments to which the benthic community is exposed decreases over time to at least this lower EC20 threshold. The Remedial Action Plan will include specific performance objectives for monitoring the Site sediments in the concentration range from 5.6 μg tPAH/g at 0.415% OC to 9.5 μg tPAH/g at 0.415% OC. The Remedial Action Plan will also include contingencies that will be implemented if the performance objectives for Natural Recovery of these sediments to levels lower than the lower EC20 threshold do not occur.

These proposed PRGs assure that all sediment RAOs in Table 1 including protection of humans, wildlife, fish and the benthic community are met.

A.3.3.3 Remedial Action Objectives for Media with No Exposure Pathways

As described in Section A.3.1.3 above, currently groundwater is not used as a potable water supply in the vicinity of the Site. Potential exposure to shallow groundwater encountered in Kreher Park fill was eliminated when the seep area was capped in 2002. Shallow groundwater encountered in the filled ravine and groundwater in the underlying Copper Falls aquifer is not currently being used for drinking water in the vicinity of the Site[3]. However, construction workers in a trench may be exposed to groundwater contaminants. For any trench excavated at Kreher Park, shallow contaminated groundwater and NAPLs can infiltrate through coarse fill materials and workers who enter the trenches can be exposed through direct dermal contact and inhalation of vapors. At the former WWTP, trespassers who enter the buildings can potentially inhale vapors and have direct dermal contact with contaminated groundwater and NAPLs that

[3] Although no contaminants were detected in samples collected from two artesian wells located in Kreher Park that obtain water from the Copper Falls aquifer, the City of Ashland restricted access to these wells for public use in August 2004. Additionally, the Site is located within the City limits and serviced by a municipal water supply.

have infiltrated the flooded lower level of the facility. The potential health risks associated with these exposure pathways have not been thoroughly evaluated by the HHRA (see Section A. 3.3.1). Direct contact exposures to NAPL or "free product" in groundwater may pose an unacceptable health risk.

Despite these data gaps, site investigation results indicate that COPCs in the shallow Kreher Park and ravine fill units and groundwater in the underlying Copper Falls aquifer exceed regulatory enforceable groundwater quality standards. PRGs for groundwater were derived primarily from Wisconsin Administrative Code (WAC) chapter NR 140 groundwater quality standards for the most frequently occurring dissolved phase organic COPCs based on historic groundwater monitoring results. The concentrations provided in the table below provide a conservative level that will be further refined in subsequent technical memoranda and the FS.

Preliminary Remediation Goals (µg/l) for
Organic COPCs in Groundwater (WAC Chapter NR 140 Enforcement Standard)

COPC – VOCs	ES	COPC – SVOCs*	ES
Benzene	5	Anthracene (LMW)	3,000
Ethylbenzene	700	Benzo(a)Pyrene (HMW)	0.2
Styrene	100	Benzo(b)Fluoranthene (HMW)	0.2
Toluene	1,000	Chrysene (HMW)	0.2
1,2,4-Trimethylbenzene	480**	Fluoranthene (HMW)	400
1,3,5-Trimethylbenzene		Fluorene (LMW)	400
Total Xylenes	10,000	Naphthalene (LMW)	40
		Pentachlorophenol	1
		Pyrene (HMW)	250
		Phenol	6,000

* (HMW) – Heavy molecular weight PAHs; (LMW) – Low molecular weight PAHs
** Trimethylbenzene (TMB) in groundwater will be presented as the sum of 1,2,4- and 1,3,5- TMB per the WAC ch. NR 140 standard.

Inorganic COPCs (metals and cyanide) were also detected above groundwater quality standards. Acceptable contaminant levels for groundwater were derived primarily from WAC chapter NR 140 groundwater quality standards for the most frequently occurring dissolved phase inorganic COPCs based on historic groundwater monitoring results. However, iron and manganese were detected in samples collected from up gradient wells[4] at concentrations above groundwater quality standards. Because these elevated concentrations represent background conditions, the

[4] Samples collected from well MW-11 located outside the ravine fill represents background conditions for shallow groundwater in the upper bluff area, and samples collected from MW-6A represent background conditions for the underlying Copper Falls aquifer.

maximum detected concentrations have been substituted as the acceptable contaminant level for COPCs that exceed groundwater quality standards in background samples. A summary of the acceptable contaminant levels for inorganic COPCs in the Miller Creek and Copper Falls aquifer follows: The concentrations provided in the table below provide a conservative level that will be further refined in subsequent technical memoranda and the FS.

Preliminary Remediation Goals (µg/l) for Inorganic COPCs in Groundwater

Inorganics	ES	Background Concentrations for Miller Creek (Well MW-11)	Background Concentrations for Copper Falls (Well MW-6A)
Arsenic	6	0 – 3.2	0 – 4.4
Antimony	10	0 – 4.3	0 – 4.1
Barium	2,000	130 – 260	640 – 710
Beryllium	4	ND	ND
Cadmium	5	0 – 0.2	ND
Chromium (+3)	100*	ND	0.87 – 2.1
Chromium (+6)			
Cobalt	40	0 – 16	0 – 1.1
Copper	1,300	2 – 35	2.4 – 6.1
Cyanide	200	0 – 17	0 – 4
Iron	300	7.1 – 19,000	0 – 0.0046
Lead	15	0 – 3.3	0.485 – 2.6
Manganese	50	13 – 760	30 – 410
Mercury	2	ND	ND
Nickel	100	0.95 – 24	1.6 – 4.7
Selenium	50	0 – 3.3	0 – 2.8
Silver	50	0 – 1.65	0 – 0.8
Thallium	2	ND	ND
Vanadium	30	2.1 – 38	9 – 10
Zinc	5,000	0 - 59	0 – 17

* Chromium in groundwater will be presented as total chromium per the WI ch. NR 140 standard

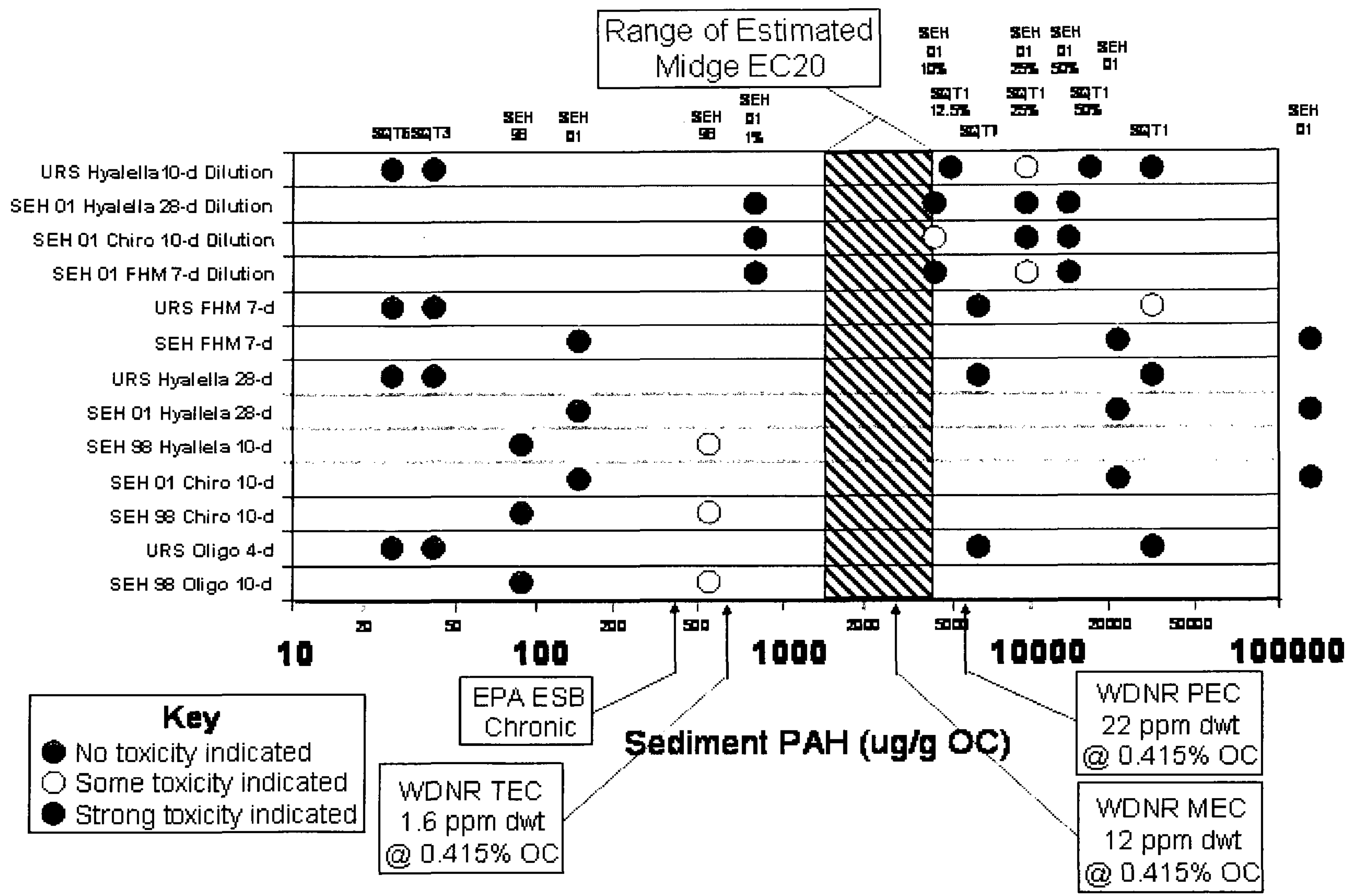
Free phase hydrocarbons (tar) encountered in the Kreher Park fill, ravine fill, NSPW property and Copper Falls aquifer are behaving as a source for the dissolved phase plumes identified in each unit at the Site. PRGs for free-phase tar are within these units are based on WAC NR 708.13, which states the following:

> Responsible parties shall conduct free product removal whenever it is necessary to halt or contain the discharge of a hazardous substance or to minimize the harmful effects of the discharge to the air, lands or waters of the state. When required, free product removal shall be conducted, to the maximum extent practicable, in compliance with all of the following requirements:
>
> **(1)** Free product removal shall be conducted in a manner that minimizes the spread of contamination into previously uncontaminated zones using recovery and disposal techniques appropriate to the hydrologic conditions at the site or facility, and that properly reuses or treats discharges of recovery byproducts in compliance with applicable state and federal laws.
> **(2)** Free product removal systems shall be designed to abate free product migration.
> **(3)** Any flammable products shall be handled in a safe and competent manner to prevent fires or explosions.

Using the above criteria, the removal of free-product (tar) will be further refined in subsequent technical memoranda and the FS.

FIGURES

Figure 1 -- Summary of Toxicity Data for Sandy Sediments



ATTACHMENT A
ESTIMATION OF MIDGE EC20 VALUES

Because NSPW/URS were unsuccessful at completing toxicity tests with *Chironomus* during the most recent investigations, the only site-specific testing with C*hironomus* across a concentration gradient in sandy sediments was the SEH (2001) dilution study. Regression analysis of these data yielded an EC20 of 4100 ug/g OC. Because of subtle differences in the slopes of the regression line, the estimated LC20 for this study was actually slightly lower, 3760 ug PAH/g OC. Because of this, the mean of these two, 3930 ug PAH/g OC is proposed as the 20% effect level for this study. An uncertainty with this value lies with the analytical characterization which contains some irregularities as pointed out previously by NSPW/URS.

The water-only fluoranthene data of Schuler et al. (2004) can also be used to estimate sediment effect concentrations. The reported water-only 10-d LC50 for *Chironomus* was 36 ug/L which, given the Kow and molecular weight of fluoranthene, corresponds to a predicted sediment LC50 of 3280 ug PAH/g OC. However, this value needs to be corrected from an LC50 to a 20% effect level. An estimate of this correction is available from the exposure response curve from the SEH (2001) sandy sediment dilution study, in which the ratio of the LC50 to the LC20, which is 6090/3760 or 1.62. Because the LC20 and EC20 were so close in this study, the lethality data were not adjusted downward further for sublethal effects. This results in an estimated LC20 based on the Schuler study of 2020 ug PAH/g OC.

Another point of reference is the toxicity of SQT7 to *Hyalella azteca*; this sediment caused about 80% mortality of Hyalella at 6080 ug PAH/g OC. Toxicity testing of this sediment with *Chironomus* was unsuccessful. However, assuming this concentration in this sediment represents an LC80 exposure for Hyalella, other data can be used to estimate a response that might be expected from *Chironomus*. One way is to look at the ratio of the *Hyalella* LC80 in the SEH (2001) sandy sediment dilution test to the *Chironomus* effect threshold mentioned above. This would be a ratio of 17800/3930 or 4.53. Dividing the PAH concentration in SQT7 by this value yields 6080/4.53 or 1342 ug PAH/g OC. Another way would be to adjust from a *Hyalella* LC80 to a *Hyallela* LC50 using the ratios of those values from the SEH (1.24) and URS (1.34; geo mean = 1.29), adjust to a *Chironomus* LC50 based on the ratio from Schuler (59/36 = 1.6 4) and to a *Chironomus* LC20 based on SEH (2001) as above (1.62). This gives an estimated *Chironomus* LC20 of 6080/ (1.29*1.64*1.62) = 1770 ug PAH/g OC.

A final method would be to estimate the *Chironomus* LC20 based on the URS (2006) sandy sediment dilution test with *Hyalella*, which gave a 10-d LC50 of 12700 ug PAH/g OC. This can be adjusted to an estimated *Chironomus* 10-d LC50 using the Schuler data (110/36 = 3.06) and to an LC20 based on SEH (2001; 1.62). This yields an estimated *Chironomus* 10-d LC20 of 12700/ (3.06*1.62) = 2560 ug PAH/g OC.